Collection Efficiency Measurement of the Modified Light-ion Multiple Target System

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The Light-ion Multiple (LIM) target system, designed by Hall in 1989 [1] was modified with the intention of increasing the collection yield to the Sample Changer System [2]. The original design has been renamed LIM1 while the modified system is named LIM2. Both LIM target systems utilize a stack of targets separated by about 1 cm alligned perpendicularly to the 88-Inch Cyclotron beam. Multiple targets are used because a light-ion beam retains enough energy after passing through a target to efficiently bombard the next target to produce the desired compound nucleus.

After passing over a bed of KCl crystals in an oven heated to 640–650 deg. C, the He jet enters the of LIM1 target system in front of the first target. The aerosol stream collects the recoils coming from the back of the target as it weaves its way through the target system. The gas jet is extracted after the last target position through a single polyethylene capillary tube. A schematic of LIM1 is shown in ref. [1].

The LIM1 target system was modified to decrease the eddy currents that were thought to be forming as the aerosol stream weaves its way from the back of one target to the next. Eddy currents would adversely affect the transport and aerosol collection efficiency by creating turbulent flow zones. They would also increase the recoil residence time in the target chamber which is a disadvantageous feature for studying short-lived isotopes. LIM2 was designed to accomodate eleven separate aerosol streams (see ref. [3]). Each aerosol stream collects the recoils from a single target. The eleven streams then recombine into one stream through a cone-shaped nozzle.

An experiment was performed to test the yields the LIM1 and LIM2. The fission yields from the ^{237}Np($^{4}He^{2+}$,9n)^{232}Am reaction using 11 ^{237}Np targets with 5 pμA of beam for several hours using LIM1 and LIM2 were measured. The LIM1 bombardment yielded about 18 fission events per hour. Six months later, the same targets, beam energy and intensity were employed to yield about 27 fission per hour with LIM2. This constitutes a 50% increase in yield with the new design that utilized separate aerosol streams for collecting recoils from each target. Thus, the separate aerosol flow streams in LIM2 increased the overall efficiency for collecting recoils. This is an encouraging development for future experiments using reactions with light-ion beams and the LIM2 target system.

References

[1] H.L. Hall, M.J. Nurmia, and D.C. Hoffman, Nucl. Inst. Meth. A 276 (1989) 649.

[2] *accepted for publication:* D.A. Strellis, et al. Nucl. Inst. Meth. A (2000).

[3] *under revision:* D.A. Strellis, Ph.D. Dissertation, University of California, Berkeley (2000).